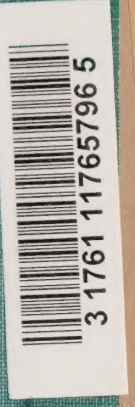

Canada. Interdepartmental
Skilled Manpower Training
Research Committee
Report

RESEARCH PROGRAM ON THE
TRAINING OF
SKILLED MANPOWER

No. 8

TECHNOLOGICAL CHANGES AND SKILLED MANPOWER:

THE AUTOMOBILE AND PARTS MANUFACTURING INDUSTRIES

Department of Labour, Canada,
in co-operation with federal and
provincial government agencies and
other groups

Reports Issued by the Interdepartmental Skilled Manpower Training Research Committee

No. 1 Progress Report (1957).

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Canada. Interdepartmental Skilled Manpower Training Research Committee. Report.

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September 1960

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FOREWORD

This report is one of a series of studies carried out under the Skilled Manpower Training Research Program initiated by the Federal Department of Labour in 1956, in co-operation with other interested federal and provincial departments and management and union organizations. The research program is under the general direction of the Interdepartmental Skilled Manpower Training Research Committee and its aims and objectives are set out in detail in Report No. 1 of this series, entitled "Progress Report", issued in June 1957.

An important phase of the Skilled Manpower Training Research Program has been the study of technological changes in selected industries and their effects on manpower and training requirements. In this phase of the program, the Committee has been greatly assisted by the tripartite Advisory Committee on Technological Change, which was set up in 1957.

This report on the automobile and parts industry is an attempt to build up a body of knowledge concerning technological change in this industry and its effects on the labour force, to serve as a basis for evaluating the problems that have arisen and the means of overcoming them.

It describes the nature of technological change in the automobile and parts industry, its effects on manpower both in aggregate and specific terms, its effects on occupations, skill levels and training. Finally, it deals with some of the human problems to which technological change gives rise.

The report was prepared by Mr. P. R. Schweitzer, under the direction of Mr. J. P. Francis and the supervision of Mr. P. Cohen of the Economics and Research Branch, Department of Labour. Field interviews with establishments in the industry were conducted by Professors W. Bruce and J. Cherna of McGill University and A. Craig of the University of Western Ontario, and by Messrs. P. Cohen and P. R. Schweitzer. Interviews with union representatives were conducted by Messrs. A. Craig and P. R. Schweitzer.

The co-operation and generous assistance received from company and union officials were most encouraging, and we gratefully acknowledge the valuable contribution of these officials to this study.

The report was prepared for publication by Mrs. D. French.

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INTRODUCTION

Technological change is an integral feature of Canada's expanding economy today. Most changes, and technological change in particular, bring with them actual or potential disruption. New products, new production processes, new materials, new designs are constantly replacing or complementing older ones and in so doing tend to create disturbances in the economic system. As a result, adjustments are continually taking place in the economy. Skill requirements are being altered, education and training needs are changing. As demands for raw materials and finished products shift, the dislocation of industry has a widening impact on employment and attendant human problems.

In a world of constant change, it becomes imperative that as much knowledge as possible be acquired about both technological change itself and its effects on the labour force. Such information helps to ensure maximum economic development with minimum hardship for those who may be adversely affected by the process of change.

This study focuses attention on the automobile and parts industries. These industries were selected for detailed analysis first because of their importance to the national economy, both in terms of manpower and value of final product, and second because their highly mechanized mass-production techniques lend themselves to all kinds of technological change, both on a small and large scale.

This report concentrates on the direct manpower effects of technological change within the automobile and parts industries, that is, its impact on employment, occupations and skills. Attention is drawn in the report to the difficulty of isolating technological change from other variables which affect employment. In this connection, no attempt has been made in the analysis of employment changes in the two industries to separate, both qualitatively and quantitatively, the impact of technological change from the effect of the market on the level of output and employment. It is realized, however, that the extent and character of the manpower effects of technological change depend, to a significant degree, on the market context in which such change occurs.

It should be realized that the effects of technological changes can be, and usually are, broader than the specific industry in which they take place. Such changes introduced in one industry may directly affect, either favourably or unfavourably, other industries in terms of production and employment. The growing substitution of aluminium for steel and copper in the manufacture of automobiles or the substitution of plastic materials for textile fabrics for car upholstery are examples of changes which have an impact on other industries. The difficulties involved in tracing, measuring and analysing such direct or primary effects of technological change on other industries have precluded their inclusion in this study.

There are also a number of secondary effects following from technological change which affect both the industry where the change is introduced and other industries. For example, technological change, insofar as it is successful, helps to improve the competitive position of a plant or industry, and the work-force of the plant or industry benefits accordingly. Technological change frequently alters the conditions under which union-management relationships have been developed and, therefore, may mean that adjustments in these relationships will be required. There are still other secondary effects which take place. These have not been explored in this study because of the difficulties mentioned in the preceding paragraph.

Establishments of four automobile manufacturers and eighteen parts supply firms, and trade union locals representing their workers, were visited during the summers of 1958 and 1959. The establishments included in the survey represent a substantial coverage of the automobile manufacturing industry but a much less complete coverage of the parts manufacturing industry. Detailed information was sought about technological changes recently introduced, their manpower effects and the problems associated with them.

Difficulties were experienced in the collection of statistical data owing to the incomplete personnel and output records of establishments, particularly for the period 1948-53. At times it was necessary to alter requests for statistics to conform with the type of data most readily available.

It is hoped that, in spite of these limitations of statistical data, this study will contribute to the understanding of the process of technological change and its effects on the Canadian labour force.

Chapter 1

Characteristics of the Canadian Automobile and Automotive Parts Manufacturing Industries

The purpose of this Chapter is to describe and explain the characteristic features of automobile and automotive parts manufacturing in Canada. These two branches are considered separately because their characteristics differ in many ways. These differences can perhaps best be explained by indicating the various steps involved in the production of an automobile. Broadly speaking, there are four main stages: component fabrication,(1) engine production, parts manufacturing(2) and assembly of the finished automobile. In this study, the "automobile industry" includes all establishments principally engaged in component fabrication, engine production and assembly of the finished vehicle. The "automotive parts industry" includes those establishments principally engaged in the production of automobile parts.

Automobile Manufacturing

The majority of the automobile manufacturing companies are engaged in engine production and assembly operations. Component fabrication is to some extent characteristic of the large companies, but parts production seems to be the exception rather than the rule.

There are a number of other distinctive features that characterize the industry. These characteristics include the small number of firms differing widely in size, the ownership and control by parent companies in the United States and the geographical concentration of production facilities. In addition, the industry is characterized by frequent changes in styling and greater than average sensitivity to business cycles.

The reasons for some of the characteristic features of the industry are not difficult to determine. Frequent style changes are one way to compete in a strongly competitive market where price competition is relatively weak. Greater than average sensitivity to business cycles can be explained by the nature of the industry's output. Automobiles are durable consumer goods

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(1) By component is meant a part of the automobile which, after assembly, becomes an integral part of the chassis, the body or the engine. Examples would include: body stampings, transmissions, axles, brake drums, clutches, pistons, etc.

(2) The word "part" is used here to denote ancillary items such as batteries, hub caps, wheels, tires, headlights, wiring, upholstery, safety glass, steering wheels and the like.

requiring a sizable outlay in cash or a long-term commitment to instalment payments. The services they yield are utilized over a span of years and the purchase of a new automobile can usually be postponed with ease. These two factors render the market for automobiles unusually sensitive to changes in the level of economic activity.

The concentration of production facilities in southern Ontario reflects the rational desire to be located near the largest markets and close to the fabricating facilities of the parent companies. The latter is most important as body stampings, almost without exception, are imported owing to the prohibitively high tooling costs which, in turn, are the result of the relatively low volume of Canadian production. The relatively small size of the market is thus a decisive determinant not only with respect to geographical location of establishments but also with respect to the type of activities that characterize the industry.

Most component fabrication for Canadian needs is carried out in the establishments of parent companies in the United States because the capital intensity of the processes involved is high and because the marginal cost of supplying Canadian demand from U.S. plants seems considerably lower than the costs of a separate establishment located in Canada. On the other hand, assembly operations are relatively labour intensive. There is, therefore, a relatively greater technical and economic justification for the maintenance of separate Canadian assembly plants. This is substantiated by the fact that in the United States assembly operations are decentralized, while fabricating facilities are usually at one location. In addition to other considerations, the lower general wage level in Canada adds incentive to the establishment of assembly facilities in Canada.

To protect the national interest, the importation of parts or finished automobiles has always been regulated in one form or another. At present, the manufacturer is obliged to maintain the Canadian content[1] of his product above a certain percentage (40 to 60 per cent,[2] depending on the volume of production) to have the privilege of importing stampings and other components not made in Canada duty free. This regulation encourages engine production and limited fabrication in Canada. Parts production is usually left to smaller firms, since they can produce more economically in limited volume.

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(1) The expression stands for "Commonwealth content" which, in practice, means Canadian content. As "Canadian content" is the better-known description of the regulations, this phrase will be used throughout this report.

(2) This percentage refers to the Canadian share of the factory cost of total number of vehicles produced in an accounting period, exclusive of taxes and duties. Factory cost takes into account all cost elements. (For details see Department of National Revenue: Memorandum Sept. 9, 1954.)

Thus, the Canadian content regulations, as well as the size of the Canadian market, have an influence on the size of the firm and its geographical location. With most of the fabricating performed in the United States, capital investment per worker is probably somewhat lower in Canada than in the United States.

Automotive Parts Manufacturing

There are approximately two hundred and fifty firms manufacturing automobile parts in Canada, ranging in size from small specialized shops with less than ten employees, to well integrated plants with over 1,000 employees. The average number of employees per firm is approximately 140.

The largest firms are usually, but not always, wholly-owned subsidiaries of U.S. corporations. Canadian-owned firms are, as a rule, smaller in size. A further important distinction needs to be made between two segments of the industry, namely, those firms that produce wholly for the automobile industry and those whose automobile parts output is but a part of total production. The larger firms tend to be more diversified both in number of products and the number of industries they service.

The parts industry has been extremely sensitive to seasonal and cyclical fluctuations in the demand for automobiles. These fluctuations are aggravated in the parts industry by changes in the "buy or make" policy of the automobile industry. Where parts manufacturers have become more diversified, they have been able to diminish to some extent their sensitivity to the ups and downs of a single industry which itself is abnormally sensitive to the economic climate.

If the relatively small size of the market is a problem in the automobile industry, it is even more of a problem in the parts industry. The parts industry has to stay competitive with United States suppliers in quality and price because the automobile companies can and do switch their purchases to suppliers in the United States if a better or cheaper product is offered, provided they are still within their minimum Canadian content requirements. The Canadian content regulations, of course, provide for a tariff if the item is ruled "made in Canada", but often such protection is not sufficient to offset the price advantage of the United States supplier. The reason for such disparity of costs arises, in large part, from the relative pace of technological change. This can be illustrated by the following hypothetical case: If in the year X a Canadian parts supply firm installs the newest machinery and the most up-to-date production processes in order to compete, the cost of modernizing because of low volume has to be spread over a considerable time. Let us say the cost will be fully amortized in the year X + 8. Meanwhile, in the United States, the cost of such modernization, because of high volume production, can be spread over a much shorter span of years, with the result

that the cost will be fully amortized in X + 4 years. The firm in the United States can now install new machinery which incorporates the improvements of the last four years. The result will be that in the four years from year X + 5 to X + 8, the Canadian supplier is no longer competitive, although only four years earlier both firms were equally efficient.

Besides rendering the Canadian supplier relatively inefficient in a short time, this disparity of speed in technological change also makes the Canadian firm wary of investing in new equipment, even if it would be to its advantage to do so at the time. The small production runs in Canada, in fact, may often force the parts manufacturer to install general purpose machinery, which is inherently not as productive as the special purpose machinery which can be used for production in the United States. In such a case the cost advantage of the foreign supplier may exist from the very first year. Frequent design changes also tend to render obsolete productive machinery or, at least, add to the overhead costs of the automotive firms.

The Canadian content regulations, however, extend a degree of protection to the industry and the tendency towards diversification reduces sensitivity to changes in the "buy or make" policy of the automobile producers.

Chapter 2

Technological Change and its Impact on Output and Employment in the Automobile and Automotive Parts Manufacturing Industries

Definition of Technological Change

Technological change is defined for purposes of this study as any change in the design or production[1] of a product. The basic motivation for introducing such changes always springs from the desire to produce a less expensive or a better product. In order to produce a cheaper or better product, changes may be made in design, in the raw materials used, in the techniques of production or in the organization of the production process itself. In practice the basic motivation for introducing a given change is often tied up with supplementary considerations. Desired changes in the volume of production, the need to replace present machinery, and expectations as to the future often influence significantly the introduction of technological changes. All these factors in turn are influenced by the state or change in the state of technological know-how.

Such changes may range in magnitude from the very small (both in terms of capital requirement and effects on manpower) to the extremely large. They may involve merely a slight change in equipment or plant layout or the installation of a complex machine with electronic controls. For certain types of technological change in production techniques which come under the heading of automation, Edgar Weinberg[2] recently proposed a classification which contains the following categories: (a) use of automatic machinery, (b) use of integrated materials handling and processing equipment, (c) automatic control systems and (d) electronic computers and data processing machines. To cover the whole range of technological changes in a qualitative framework, the following categories must be added: (e) changes in design and/or methods of fabrication, (f) changes in raw materials, (g) changes in layout, (h) improved non-automatic machinery, (i) improved hand tools, or a combination of two or more of the foregoing.

The technological changes that have been introduced in both the automobile and automotive parts manufacturing industries during the past ten years range from the very small to the very large in each category. Nevertheless, the impression is gained that certain types of change were more frequently introduced in the industry than others. The most frequently encountered types of change were the advanced mechanization of materials handling and work

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(1) The term production is used here to include some distributive functions, such as loading of freight cars.

(2) Monthly Labour Review, Feb. 1955, Vol. 78, No. 6, p. 637.

positioning devices, utilization of new materials in the production of parts and components, the introduction of better tools, and small changes in layout of production facilities. The introduction of fully automated machinery did not seem to occur often enough to be characteristic of technological change in the two industries under review, yet when it did occur it tended to have the greatest effects on manpower, both in terms of the kind and the amount of manpower required.

A further characteristic of technological change in the two industries lies in the timing of larger changes. A large majority of them seem to have been introduced during the model changeover periods, following a relatively high-volume year in the industry.

With regard to the cumulative manpower effects of technological change, it may be well to quote Professor A.L. Gitlow(1) to introduce the reader to the difficulties that have to be faced when an assessment is attempted.

> "The effects of technological change upon employment are usually indirect for there is no necessary concurrence in time and place between a specific change in technology and the displacement of large groups of employees. Where the introduction of an innovation generally through an industry is involved the repercussions may cover a long period of time. For such a lengthy period, wars, business cycles, new innovations, fiscal and monetary changes, social and political changes, alterations in international trade, and so on enter and complicate the economic picture. The dynamic world in which technological change occurs makesit most difficult if not impossible to isolate its effects."

In the Canadian automobile industry, there are some factors not mentioned in the quotation which make even more tenuous the link between output and manpower data and productivity changes due to technological improvements. First, there are reasons to assume that in the ten-year period 1948 to 1958, extensive changes in the quality of the product have taken place. Second, consolidation and extension in manufacturing facilities occurred with the result that some components that used to be imported or bought are now manufactured by Canadian automobile firms themselves. There are instances, of course, where manufacturing of a component or part was reduced or discontinued and replaced by a purchased or imported product. A case in point would be the decline in the production of standard transmissions which were replaced with imported automatic transmissions. Third, changes in the volume of production are a key variable with respect to total employment of which not enough is known. This is true particularly in regard to changes in the volume of

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(1) A.L. Gitlow: Labor Economics and Industrial Relations, p. 556. Richard D. Irwin Inc., Homewood, Ill., 1957.

production that are not directly demand induced but rather hinge upon discretionary management decisions affecting changes in production allocation. The possibility for such management decision arises usually because excess capacity exists in the Canadian establishments. Such excess capacity may be utilized by producing parts and components that are normally produced by feeder industries, or by producing an increased volume of certain parts that normally would be produced in the United States. The former constitutes a change in the "make or buy" policy and is carried out quite frequently. The latter occurs less frequently and without any pattern over time. It may occur because of the desire to utilize existing excess Canadian capacity either for exports or to produce components for parent company plants in the United States. The increased Canadian production tends to raise total employment or at least maintain total employment in the Canadian establishments, in most cases temporarily.

Under the circumstances, the following comparisons are presented as rough approximations only. The only statement that can be safely made from these comparisons is that a large proportion of the changes in output per worker can probably be ascribed to the effects of technological change. Where an increasing trend is evident in the "output per worker" statistics, quality changes, price level changes, variations in volume and variations in hours worked may be significant factors as well.

The Period Selected for Review

The period to be reviewed was chosen with regard to two considerations. First, the latest information available at the commencement of the study related to the calendar and model years 1958 and accordingly this date was selected as one of the reference dates. The wish to avoid the inclusion of the war years and the subsequent adjustment period in the analysis governed the selection of 1948 as the second benchmark year; this had the added attraction of defining the period under review as a decade. 1953, the year dividing the decade into two five-year periods, was a logical choice as the third reference date. Later in the study it was found that 1953 was characterized by somewhat special circumstances, such as an extraordinarily high volume of output, and it was thought advisable to add the year 1954 as an additional benchmark date.

The year 1948 was marked by a high level of economic activity. In the last quarter, economic activity reached a peak in its cyclical pattern and levelled off, bringing an expansion phase to an end. The year 1953 was characterized by very much the same pattern of economic activity, except that the recession that started in the fourth quarter was somewhat more severe than that of 1948 and early 1949. The years 1954 and 1958 were periods with relatively low levels of economic activity. In both years the lower turning points of the

business cycle occurred around the middle of the year. Thus both years evidenced both contraction and expansion in economic activity albeit at relatively low levels.

Comparative Increases in Output and Employment in the Automobile Manufacturing Industry

There are three different kinds of output data available for the automobile industry, not including the automotive parts industry, for the period 1948-1958. Output data are available in terms of total number of units produced, in terms of value added by manufacture, and in the form of a weighted volume index computed by the Dominion Bureau of Statistics.(1) Each set of data, together with the gross selling price of the units produced, is shown below for the years 1948, 1953, 1954 and 1958.

Table 1 - Output of the Canadian Automobile Manufacturing Industry, 1948-1958 (Selected Years)

Year	Passenger cars	Other types of vehicles	Total units produced	Value added in manufacture in millions of current dollars(1)	Weighted volume index(2)	Gross selling price in millions of current dollars(1)
					1949=100	
1948	166,819	96,941	263,760	145.6	89.7	398.1
1953	360,385	120,574	480,959	273.6	164.4	835.6
1954	287,191	69,892	357,083	176.5	130.7	666.3
1958	298,349	61,428	359,777	253.9	138.6	847.3

(1) The data are presented in current dollars as no available deflating factor was considered satisfactory.

(2) This index is a commodity weighted volume index. Its characteristics are reviewed in detail in the notes to Reference Paper No. 34 Rev., DBS.

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(1) All data on production and manpower in the two industries are to be found in the three DBS publications listed below:

DBS: The Motor Vehicle Industry 1958 and previous years.
DBS: The Motor Vehicle Parts Industry 1957 and previous years.
DBS: Revised Index of Industrial Production 1935-1957 (1949=100) Reference Paper No. 34 Rev. Cat. No. 61-502.

Average annual employment in the industry for the same period is indicated below.

Table 2 - Employment in the Canadian Automobile Manufacturing Industry, 1948-1958 (Selected Years)

	Total employment	Direct production labour(1)	Direct production labour(1) as per cent of total employment
1948.....	24,703	20,457	82.8
1953.....	32,973	26,890	81.6
1954.....	27,949	21,518	77.0
1958.....	26,396	19,128	72.5

(1) "Direct production labour" includes all employees except executive and supervisory officials, managers, professional employees, superintendents and factory supervisors above the working foreman level, those engaged in retail or wholesale sales, new construction and the clerical staff of the foregoing.

Thus production (in units) increased in the ten years approximately 36.4 per cent, in value added (not deflated) about 75 per cent, and the volume index shows an increase in production of 54.6 per cent, while total employment increased about 7 per cent. It is interesting to note that the increase in total employment obscures divergent trends with regard to direct and indirect labour. The proportion of direct labour expressed as a percentage of total employment was 82.8 per cent in 1948, 81.6 per cent in 1953, 77.0 per cent in 1954 and 72.5 per cent in 1958. Indeed while total employment increased 7 per cent during the period 1948-1958, the number of employees engaged in direct production fell approximately 6½ per cent during the same period.

Moreover, during the decade there was a reduction of hours worked per week in the industry. According to the Dominion Bureau of Statistics the average hours worked per week in the Motor Vehicle Industry decreased from 39.7 hours in 1948 to 38.3 hours in 1958.(1)

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(1) Review of Man Hours and Hourly Earnings 1945-1958, Table 3, p. 21, DBS.

The information seems to indicate a sizable increase in productivity. Owing to the various difficulties discussed at the beginning of the chapter in computing "output per worker" or similar data, it is not possible to determine the magnitude of the increase with any accuracy. Accordingly, no such measure is presented, although three different kinds are potentially available.

The implications of a sizable increase in productivity are several. First of all it means that a given work force is now able to produce a greater volume of output than was the case in 1948. It further means that any expansion of production will induce a slower increase in total employment than it would have caused in 1948. This latter effect is particularly significant with regard to the possibilities of new entrants to the labour force who wish to enter the industry. If no expansion, or too slow an expansion, of output occurs it may result in the movement of human resources out of the industry. Lastly it implies a considerable increase in capital investment per worker in 1958 relative to 1948. Logically such an increase in capital equipment per worker tends to increase employment opportunities in maintenance relative to production within the plant and industry, and tends to increase employment opportunities in the capital goods industries assuming that output of the industry where the change occurred does not fall drastically.

Although increased employment opportunities in maintenance work are evident in Canada to some extent, increased employment in the capital goods industries as a potential offset to possible displacement does not exist to a significant degree, since the bulk of the production machinery is imported.

Comparative Output and Employment in the Automotive Parts Industry

In the automotive parts manufacturing industry, owing to the great diversity of products, output data are available only in terms of value added by manufacture, and in terms of a weighted volume index computed by the Dominion Bureau of Statistics. These indicators are shown below for the years 1948, 1953, 1954 and 1957.

Table 3 - Output of the Canadian Automotive Parts Manufacturing Industry, 1948-1957 (Selected Years)

	Value added by manufacture in millions of current dollars[1]	Weighted volume index[2]
		1949=100
1948.....	67.7	90.0
1953.....	141.3	146.1
1954.....	112.3	114.2
1957.....	144.2	121.5

(1) The data are presented in current dollars as no available deflating factor was considered satisfactory.
(2) This index is a commodity weighted volume index. Its characteristics are reviewed in detail in the notes to Reference Paper No. 34 Rev., DBS.

Average annual employment in the industry for the same period is tabulated below.

Table 4 - Employment in the Canadian Automotive Parts Manufacturing Industry, 1948-1957 (Selected Years)

Total employment		Number of workers in direct production[1]	Direct production workers[1] as per cent of total employment
1948.....	16,388	13,820	84.3
1953.....	23,335	19,425	83.2
1954.....	18,363	14,673	79.9
1957.....	20,426	15,996	78.3

(1) The term includes all employees except executive and supervisory officials, managers, professional employees, superintendents and factory supervisors above the working foreman level, those engaged in retail or wholesale sales, new construction and the clerical staff of the foregoing.

No information is available regarding average hours of work per week in the automotive parts manufacturing industry for the years 1948 and 1949. During the next eight years average hours per week decreased from 42.5 hours in 1950 to 39.5 hours in 1958.(1)

Thus, while production increased by 35 per cent, according to the volume index, and by 113 per cent in terms of value added (not deflated), total employment increased approximately 25 per cent. At the same time average hours worked decreased probably somewhat in excess of 8 per cent. What has been stated in connection with the data from the automobile industry is equally true of the parts industry, with the notable exception that the gain in productivity seems smaller.

The tendency for direct production workers to constitute a decreasing proportion of total employment, as evidenced in the automobile industry, is apparent also in the parts industry, but to a lesser degree. Direct production workers accounted for 84.3 per cent of the total labour force in the industry in 1948, 83.2 per cent in 1953, 79.9 per cent in 1954 and 78.3 per cent in 1957.

Various other shifts and changes have taken place in the composition of the labour force of the two industries owing to changing technology. These shifts and occupational changes will be subjected to a closer analysis in the next chapter.

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(1) Review of Man Hours and Hourly Earnings 1945-1958, Table 3, p. 21, DBS.

Chapter 3

The Effects of Technological Change on Occupations and Skills

In this chapter an attempt will be made to evaluate the impact of technological change on the composition of the labour forces of individual establishments and of the two industries as a whole. The fact that significant changes have occurred during the decade in the occupational composition of the labour forces is indicated by the changing proportion of direct production workers and those engaged in indirect production as shown in Chapter 2. Presumably technological change does have a differential impact on occupations, functions and skill composition of the labour force.

The incompleteness of the data and the fact that those available covered time periods of various durations, prevented a full inquiry into the effects on manpower of technological change. Furthermore, not all of the changes could be ascribed to the effects of changing technology. Changes in the volume of production, variations in policy as to what should be bought and what manufactured, changes in quality of final output, tasks that are performed today that were not considered necessary in the past, are determinants with an important bearing on the number and occupation of workers employed. It seems impossible therefore to exclude the manpower effects of variables other than changes in production technology.

The shortcomings of the data, which forced the analysis in most cases to rest on information submitted by relatively few establishments, made it desirable to extend our analysis to data available from the Department of Labour's annual Wage Rate Survey. The characteristics of this mail survey, of which the main advantage for occupational analysis is its broad coverage, will be described later in the chapter. It should suffice to state at this point that the occupational information derived from the annual Wage Rate Survey differs considerably from that collected in the field with regard to sources, methods of collection and definitions. Consequently, the two sets of data do not lend themselves to specific comparisons. The most that can be assumed is that broad tendencies in occupational changes will more or less confirm the information gained through the field work, yet even there the narrowly based information may show a different trend due to some special characteristics of the very limited number of establishments under review.

The analysis of both types of information will attempt to describe the changes which have occurred in the occupational composition and skill level composition of the labour forces, keeping in mind that these changes reflect the results of all determinants, and are not merely the effects of changes in production technology. Wherever it is possible, it will be pointed out what other factors had an important influence in inducing the demonstrated change in manpower requirements.

The various skill levels that play a significant role in the analysis are defined in terms of the length and type of training needed to learn the

particular skill. Skills which can be learned informally in less than one week are classified as unskilled. Skills which require over two years of trade training are classified as skilled and any skill that can be acquired in more than a week but less than two years is classified as semi-skilled. Professional occupations require four years of university education or the equivalent. Technician jobs are at a level between that of the professional engineer or scientist and the skilled tradesman.

Comparisons of Salaried and Hourly-Rated Personnel in the Automobile Manufacturing Industry

The analysis of occupational information obtained through field interviews demonstrates that the most obvious change in manpower composition during the period 1948-58 has been the changing proportion of salaried to hourly-rated personnel.

Table 5 - Salaried Employment as Proportion of Total Employment in the Canadian Automobile Manufacturing Industry, 1948-1958 (Selected Years)

	1948	1953	1958
	%	%	%
In three assembly and fabricating establishments.....	16.6	20.3	27.6
In two engine-manufacturing establishments.....	8.6	10.4	16.1

The information in Table 5 demonstrates on the one hand the increasing proportion of salaried workers in total employment, and on the other hand draws attention to the very obvious differences existing between the proportion of salaried employment in engine manufacturing and assembly and fabrication operations. It is to be noted that some groups of workers in certain occupations previously hourly rated were reclassified as salaried during the period. In absolute terms hourly-rated employment stayed constant or declined slightly during the ten years, while salaried employment increased. In two establishments where information was available for the period 1948-1958, the proportion of women employed among salaried personnel declined significantly, (from 35 to 25 per cent and from 33 to 25 per cent) but in absolute numbers more women were employed by both these establishments in 1958 than in 1948 or in 1953.

An analysis of the salaried personnel in one large fabricating and assembly establishment, whose salaried staff had increased 116 per cent in the

period 1948-1958 and 34 per cent in the five years 1953-1958, revealed that the number of foremen had tripled over the decade and had increased 27 per cent over the last five years. The number of graduate engineers had increased 60 per cent and 26 per cent respectively during the same periods.

In another establishment which manufacturers engines, foremen in 1955 accounted for 4.2 per cent of the plant labour force but by 1959 constituted 6.2 per cent. Engineering graduates accounted for 1.1 per cent and 1.6 per cent of the total plant labour force in 1955 and 1959 respectively.

The growth of salaried personnel in four departments of a large automobile company is shown in Table 6, using index numbers.

Table 6 - Index of Growth of Salaried Personnel in Four Departments of a Large Automobile Company, 1948-1958

(1948=100)

	General administration	Engineering	Manufacturing administration	Purchasing	Total salaried employment
1948.....	100	100	100	100	100
1953-54.....	158	109	192	150	158
1958.....	200	135	282	167	215

It is interesting to note the relatively slow expansion of the engineering department. One of the reasons for this slow growth is that a considerable portion of the engineering work is, and has been, done by parent companies outside Canada. Another reason is the relative independence of engineering work from volume of output.

The fast rate of growth of manufacturing administration, according to company officials, is due to the rapid increase in employment of a key group of people with special qualifications, such as those engaged in production planning, scheduling, quality control and complex inspection, and time study. This is substantiated by data from another large assembly and fabricating establishment where salaried employees engaged in production planning, scheduling, time study and similar activities constituted 6.8 per cent in 1948, 13.5 per cent in 1953 and 14.5 per cent in 1958 of total salaried employment.

Two engine plants in the survey present a slightly different picture. The engineering departments in both expanded faster than total salaried employment, no doubt because of increasingly complex advanced mechanization of machine lines. The functions of production planning and production control also play an increasingly important role in the engine plants. The engineering department in one establishment accounted for 23 per cent of salaried employment in 1948, and 31 per cent in 1958.

Changes in the Employment of Skilled and Other Tradesmen in the Automobile Manufacturing Industry

Skilled tradesmen in assembly and fabricating establishments increased in numbers during the decade, but the ratio of skilled workers to total hourly-rated employment remained constant. However, it is worth noting that a slight proportional increase is evident in the two smaller of the three establishments. In the high volume year of 1953 skilled tradesmen in all three establishments constituted a smaller proportion of total hourly-rated employment than in either 1948 or 1958. This suggests that in the short run changes in the manpower requirements for skilled tradesmen are somewhat independent from volume of output, primarily because of the existence of excess capacity in the industry establishment.

Table 7 - Employment Indices for Skilled Tradesmen in Three Assembly and Fabricating Establishments, 1948-1958*

(1948=100)

Establishment	1948			1953			1958		
	Total hourly-rated employment	Skilled trades	Skilled tradesmen as % of hourly-rated employment	Total hourly-rated employment	Skilled trades	Skilled tradesmen as % of hourly-rated employment	Total hourly-rated employment	Skilled trades	Skilled tradesmen as % of hourly-rated employment
A.....	100	100	10	151	101	7	102	120	11
B.....	100	100	12	155	125	10	56	58	14
C.....	100	100	10	193	150	7	212	208	10
Total for three establishments.....	100	100	10	168	137	8	160	160	10

* In this table, as well as in those that follow, codes are assigned to establishments on an ad hoc basis. A, B and C in different tables do not refer to the same establishments.

The engine plants report a somewhat different situation. In one establishment skilled tradesmen accounted for 10 per cent of hourly-rated employment in 1948 and 15 per cent in 1958. In another similar establishment the proportion of skilled tradesmen to hourly-rated employment changed from 18 per cent in 1955 to 20 per cent in 1959. In the latter case although there was an increased proportion of skilled tradesmen there was a somewhat smaller number of skilled tradesmen employed in 1959. The aggregate figures do not mean that the relative importance of departments employing the bulk of skilled tradesmen did not change, nor does it exclude the possibility that the occupational composition of the skilled trades group changed over time.

Most of the skilled tradesmen in the automobile industry are employed in the maintenance department and the tool room. Data from three establishments are available showing changes in manpower in these two departments over the period 1948-1958. These are presented in Table 8.

Table 8 - Employment in Maintenance and Tool Room Departments(1) as a Percentage of Total Hourly-Rated Employment, 1948-1958

Establishment	1948		1953-54		1958	
	Maintenance	Tool room	Maintenance	Tool room	Maintenance	Tool room
A.....	-N	-N	14	7	7	2
B.....	-N	-N	3	3	4	4
C.....	4	6	4	4	5	5
Total for three establishments.	-	-	4	4	5	4

(1) Includes both engine plants and other types of establishments.
- Not available.

Table 8 shows a slight increase in the proportion of skilled tradesmen engaged in maintenance work. The data for establishment A show a different tendency, but this is largely because both departments were heavily overstaffed in 1953. The slight increase in skilled tradesmen engaged in maintenance work was explained by company and union officials as follows: Due to more expensive and more complex equipment, management was placing greater stress on preventive maintenance. The more expensive and complex machinery renders any breakdown, and the ensuing "downtime", much more costly than used to be the case. Integration of machine lines by complex transfer machinery also contributes heavily to the increasing expense of "downtime". If any machine in the integrated line breaks down, it renders the entire line idle. Previously, if any interruption of production occurred due to machine failure, only the machine that had broken down became idle. Under the circumstances, management has increased preventive maintenance and this has tended to decrease conventional repair and maintenance work. On balance, it seems that proportionately more skilled tradesmen are involved in maintenance work than in the past.

Regarding the proportional changes of skilled tradesmen in the tool room, there is very little that can be said, because no information is available on the amount of tool and die work and fixture work contracted out at various times by different establishments. The impression gained through discussion with both management and trade union officials is that there has been some increase between 1948 and 1958 in the amount of tool and die work contracted out.

Within the skilled trades category, the occupational mix underwent significant changes during the same period. Table 9 presents information relative to such changes obtained in two assembly and fabricating establishments One was rather small in terms of total employment and the other was relatively large, thereby having a dominant effect on the totals. Table 10 presents similar data for an engine plant. The information was collected for the month of May each year, on the assumption that it would represent a reasonably good example of employment in a full production period.

Despite these limiting qualifications, it is felt that the data in Tables 9 and 10 represent a reasonable approximation of the occupational changes that have taken place in the assembly and fabricating establishments.

Table 9 - Relative Changes in the Employment of Skilled Tradesmen by Trade in Two Assembly and Fabricating Establishments, 1948-1958

(1948=100)

	Total skilled trades empl.	Toolmakers	Machinists	Electricians	Machine & tool repairmen	Millwrights	Pipe fitters	Patternmakers	Tool & die makers	Welders	Carpenters	Tinsmiths	Welding equip. maintenance
1948..	100	100	100	100	100	100	100	100	100	100	100	100	-
1954..	207	212	119	202	99	204	132	84	104	60	226	160	increased from 0 to 8
1958..	195	276	122	283	105	236	200	139	157	115	288	260	increased from 0 to 15

In the first column of Table 9, the rate of growth of all skilled trades is shown to provide a yardstick against which the growth of individual skilled trades can be evaluated. It will be noted that the trades can be divided roughly into three groups: those that grew in numbers very much faster than all trades grouped together; those that lagged far behind; and those that approximately managed to maintain their relative importance In the first group are the toolmakers, electricians, millwrights, carpenters, tinsmiths and welding

equipment maintenance workers. The second group includes machinists, machine and tool repairmen, patternmakers, tool and die makers and welders. Pipefitters constitute the third group.

It is interesting to note that the rate of growth or decline of individual trades is uneven in the ten-year period 1948-1958. The trades that showed a relatively small increase from 1948 to 1958 almost all evidenced a decline in the first six years. Electricians and toolmakers in the first six years roughly kept pace with the increase in the employment of all skilled tradesmen. From 1954-1958, however, employment in these two trades increased at a more rapid rate than most of the other trades. The number of tool and die makers remained almost constant in the first six years while total skilled employment doubled, but this group regained some of its relative importance in the later period. Millwrights held their own in the first six years, but during the last four years gained in relative importance.

The same information for an engine manufacturing plant is presented in Table 10.

Table 10 - Relative Changes in the Employment of Skilled Tradesmen in Selected Trades in One Engine Manufacturing Establishment, 1948-1958

(1948=100)

	Total skilled trades	Machine repair	Electricians	Mill-wrights	Steam-fitters
1948....	100	100	100	100	100
1953....	124	124	133	136	100
1958....	140	128	200	155	130

Table 10 evidences somewhat different trends than were found in assembly and fabrication operations. Total skilled trades employment in Table 10 increased in absolute terms but not to the same extent as in assembly and fabrication. As was stated earlier, however, the increase in skilled tradesmen, expressed as a proportion of total hourly employment, was actually greater in the case of engine manufacturing. A notable difference is that the number of machine repair tradesmen in engine manufacturing increased at a faster rate than in assembly and fabrication - in the latter case the number increased only slightly over the ten-year period. Of the four trades shown in

Table 10, electricians and millwrights expanded faster than total skilled trades employment but the rate of growth was not as great as that shown for these two trades in Table 9. Machine repairmen and steamfitters in engine manufacturing increased at a slower rate than total skilled trades employment and also lost ground relative to electricians and millwrights.

Interest was centred on a number of occupations, other than the skilled trades dealt with above, which were thought to have changed considerably in relative importance as a result of technological change.

One of these occupations was that of inspector. It has been claimed that an increasing number of people at various skill levels are required to carry out inspection duties. This was found to be true in all establishments where data were obtained as demonstrated in Table 11.

Table 11 - Growth of the Inspection Function in the Automobile Manufacturing Industry, 1953-1959

Establishment	1953-55	1958-59
	% of total hourly-rated employment	
A	1.9	3.6
B	4.8	8.0
C	3.0	4.6
D	7.8	8.2

Establishments B and D are engine plants and it will be noted that these have a higher proportion of inspectors than establishments A or C.

The data also indicate an upgrading in skill requirements among the inspectors. In one establishment in 1953 no inspector was in the skilled category; by 1958, 21 per cent of the inspection staff were skilled employees In establishment B, it was found that whereas in 1954 about 4 per cent of the inspection staff was above the semi-skilled level, in 1958 about 25 per cent of an increased inspection staff consisted of inspectors with higher than semi-skilled classification.

Below the skilled level, occupations of particular interest were assemblers, machine operators, tool grinders and unskilled material handlers.

Assemblers, generally speaking, were not very much affected by changes in production techniques. The reason is that assembly operations have thus far lent themselves less readily to mechanization than have fabrication or machining operations. In one establishment, where information was available on all workers engaged in assembly operations, assemblers accounted for 71 per cent of hourly-rated employment in 1953, and 64 per cent in 1958. In another similar establishment, information was available only for the body and chassis division and excluded assemblers on certain sub-assembly operations; however, within the body and chassis division the assemblers represented 52 per cent of hourly-rated employment in 1954 and 48 per cent in 1958.

Similarly, one engine plant reported a slight decrease in the proportion of assemblers: 18 per cent of hourly-rated employment in 1955 and 17 per cent in 1959. The second engine establishment reported a slight proportional increase in the employment of assemblers: 11 per cent of total hourly-rated employment in 1954 and 14 per cent in 1958.

In a third establishment, where machine operators were grouped with assemblers, the two occupations together accounted for 73.5 per cent, 69.0 per cent and 59.4 per cent of total hourly-rated employment in 1948, 1953 and 1958 respectively.

The single category of semi-skilled machine operators, in the one establishment that provided this information, made up 28.4 per cent of hourly-rated employment in 1955 compared with 25.5 per cent of total hourly-rated employment in 1959. The establishment that submitted the information was using highly mechanized production processes in the base year 1955, and consequently had relatively few technological changes during the next four years. Accordingly it is felt that the small decrease in the proportion of semi-skilled machine operators to total hourly-rated employment may not be typical of the industry.

Tool grinders in the engine plants seem to have slightly increased in relative importance. Their proportion of total hourly-rated employment in one establishment increased from 2.9 per cent in 1948 to 4.0 per cent in 1958.

The employment of unskilled material handlers declined sharply in the period 1948-1958; the decline ranged from 33 per cent to 50 per cent. Estimates given by management and union officials range even higher. Whatever the exact magnitude of the decline, there is no doubt that these types of jobs were most susceptible to mechanization. A number of workers were retrained to operate materials-handling equipment.

In the discussion of occupational changes that have taken place in the industry, changes in content of jobs within an occupational classification have so far been neglected. It is well known that extensive changes do occur in job content in terms both of duties and skill requirements. Unfortunately not enough information is available to analyze such changes in any detail. The only instances where these changes are taken into account are those that involve so extensive a change that a new occupational title is created either at the same or a different skill level.

The skill level distribution of hourly-rated workers in two assembly and fabricating establishments during 1957-1958 seems to be approximately as follows:

Unskilled	44.2 per cent
Semi-skilled	43.6 per cent
Skilled	11.1 per cent
Technicians	1.1 per cent

Employment of salaried technicians and employment in the professional categories, excluding management, account in all probability for less than 2 per cent of total employment.

The engine plants report a somewhat different skilled distribution of their hourly-rated personnel. The three establishments combined show the following pattern:

Unskilled	13.6 per cent
Semi-skilled	67.0 per cent
Skilled	18.8 per cent
Technicians	0.6 per cent

In this case employment of salaried technicians and professionals in all probability accounts for approximately 1 per cent of total employment.

The general skill level in the automobile industry seems to have increased slightly with expansion of employment in certain trades and the elimination of a fairly large number of unskilled jobs by increasing mechanization.

It should be emphasized that the data and their analysis are restricted to the automobile industry itself. It is reasonably certain that changes in "make or buy" policy, and particularly changes in the amount of work contracted out to other firms, have significantly influenced total employment in the automobile industry, as well as employment in specific trades and occupations. It was stated for instance that an increasing amount of tool and die work is "contracted out" by the automobile firms. If this is the case, it may explain the relatively small increase in the employment of tool and die makers over the period 1948-1958.

Changes in Occupations and Skills in the Automotive Parts Industry

No assessment of manpower changes was possible in the automotive parts industry. The variety of products and the various scales of operations make the different firms for all practical purposes not comparable. To demonstrate their incomparability the skill composition of their hourly-rated labour forces is presented below:

Table 12 - Hourly-Rated Employment in the Automotive Parts Manufacturing Industry According to Skill Levels, 1957-1958

Based on Information from 14 Parts Supply Firms

Automotive Parts Industry			Automobile Industry (assembly and fabricating)
Skill levels	Range	Median	
	%	%	
Unskilled.....	23-81	52.25	44
Semi-skilled.....	13-55	23.00	44
Skilled.....	4.5-42	16.75	11
Technicians.....	0-6	1.75	1

It was found that, by and large, a higher proportion of the parts industry labour force is engaged in indirect production than is the case in the automobile industry. The inspection function is an exception; a greater proportion of workers are employed in this field in the automobile industry. A possible explanation of this exception may lie in the rapid expansion of inspection departments in the automobile industry, which occurred in response to the need for stricter quality control. The proportionately greater employment in the automotive supply firms in fields such as maintenance, engineering and tool room may partially be explained by the relatively smaller size of establishments and the different output of the industry.

Occupational Trends in the Automobile and Automotive Parts Manufacturing Industries Based on Data Obtained from Department of Labour Annual Survey of Wage Rates

In an attempt to throw further light on employment trends in various occupations in the automobile and parts manufacturing industries, data from the annual survey of wage rates conducted by the Department of Labour have been analysed. In this survey, data are reported by individual establishments on the number of workers at each rate of pay in selected occupations. Short descriptions of the occupations for which data are requested are on the survey forms.

Information has been analysed from the annual wage survey data for the period 1950-1959. The coverage of the survey is much broader than that of the data obtained in the field for this study, both in respect to number of establishments and variety of occupations covered. However, it must be pointed out that the survey is conducted at a certain time each year and all information relates to a single wage period. Establishments are requested to report on the "normal" pay period closest to October 1 each year. Different types of establishments are requested to report on various groups of occupations according to the importance of the occupations in their operations. The primary purpose of the survey is to collect information on wage rates and although the number of workers employed is shown, the accuracy of such employment data has never been independently tested. It is felt, however, that despite its drawbacks, the occupational information obtained through the wage rate survey represents the best information available at this time and can be usefully employed to complement and augment the data obtained in the field, particularly for the automotive parts manufacturing industry, where this is the only historical information available.

Table 13 presents employment data for specific occupations in the automobile industry for the period 1950-59 and Table 14 presents similar data for the automotive parts industry. Table 13 is based on returns from six establishments which comprise the greater part of the automobile industry. Table 14 is based on returns from eight parts establishments, which were considered representative of the parts industry. The working force in each parts manufacturing establishment ranged from 100 to 1,000 persons.

For the purpose of determining trends in the employment of various occupations, it seems advisable not to rely on any year-to-year comparisons, as it is quite possible that special circumstances or poor reporting in a given year may seriously distort the conclusions. Accordingly this analysis is based on the average employment in each occupation in the first and last three years of the period for which data are available. Even if the analysis is carried out in this manner, the exact magnitude of the change may not be too accurate. The data, however, are very useful for pointing up occupational trends as indicated by the relative change in the employment in any given occupation compared with the change in total non-office employment in the industry.

It must be pointed out again that the information presented in Tables 9 and 13 are not comparable. While both sets of data refer to the automobile manufacturing industry, the time period covered, the date at which the information is collected, the number of establishments covered and the methods of collecting the information are different to such a degree that no reasonable comparisons can be made.

Table 13 - Occupational Trends in the Automobile Manufacturing Industry, 1950-1959
(Selected Occupations in Six Establishments)

	Total empl.	Total non-office	Assembler	Body trimmer	Carpenter	Electrician	Grinder Operator	Inspector	Machinist	Machine repair	Machine operator	Metal finisher	Millwright	Spray painter	Pipe fitter	Sheet metal worker	Tool & die + toolmaker + jig and fixture man	Power trucker	Welder (torch)	Machine welder
Average employment for years 1950-1951-1952.....	30,736	25,009	4,623	392	64	224	278	768	75	180	2,559	944	224	324	117	267	337	221	113	1,028
Average employment for years 1957-1958-1959.....	29,970	22,116	4,454	283	51	317	199	901	84	327	902	723	296	367	199	320	555	455	181	1,586
Per cent change.....	-3%	-12%	-4%	-28%	-20%	+42%	-28%	+17%	+12%	+82%	-65%	-23%	+32%	+13%	+70%	+20%	+65%	+106%	+60%	+54%
Change in employment of occupation relative to total non-office employment.....			+	-	-	+	-	+	+	+	-	-	+	+	+	+	+	+	+	+
Number of establishments reporting on occupation.....			5	4	5	5	4	5	4	5	4	4	5	5	4	3	5	5	5	4

Explanation of signs:
+ = proportion increased.
- = proportion decreased.

Table 14 - Occupational Trends in the Automotive Parts Manufacturing Industry, 1950-1959
(Selected Occupations in Eight Establishments)

	Total employment	Total non-office employment	Assembler	Machine operator	Heat treater	Set-up man	Inspector	Spray painter	Machine moulder	Floor & bench moulder	Machine welder	Carpenter	Electrician	Pipe fitter	Tool & die maker	Millwright	Machinist	Mechanic	Welder (maintenance)	Power trucker	Labourers
Average employment for years 1950-1951-1952.....	4,372	3,870	377	830	31	108	209	28	78	11	22	10	29	8	78	30	18	51	8	15	542
Average employment for years 1957-1958-1959.....	3,212	2,527	275	461	35	37	344	7	30	7	13	9	26	9	54	46	18	27	13	19	264
Per cent change.....	-27%	-35%	-27%	-44%	+13%	-66%	+65%	-75%	-62%	-36%	-41%	-10%	-10%	+13%	-31%	+53%	-	-47%	+84%	+27%	-51%
Change in employment of occupation relative to total non-office employment.....			+	-	+	-	+	-	-	*	-	+	+	+	*	+	+	-	+	+	-
Number of establishments reporting on occupation.....			6	8	6	6	8	6	2	2	6	6	8	6	6	8	8	6	8	8	8

Explanation of signs:
+ = proportion increased.
- = proportion decreased.
* = proportion stayed within ± 5 percentage points.

Table 13, as well as the subsequent Table 14, confirms the fact that office employment as a proportion of total employment has increased substantially during the period 1950-1959. In the automobile manufacturing industry office employment as a proportion of total employment increased from 18.7 per cent to 26.2 per cent, while in the parts manufacturing industry the proportional increase was from 11.5 per cent to 21.3 per cent.

Trends in the employment of specific occupational groups, which are demonstrated in Table 13, indicate that substantial proportional increases in employment were evidenced by electricians, inspectors, machinists, machine repairmen, millwrights, spray painters, pipe fitters, sheet metal workers, occupations in the tool and die maker group, power truckers, torch welders and machine welders. A slight proportional increase is shown in the case of assemblers, while body trimmers, carpenters, grinder operators, machine operators and metal finishers show a decline in their employment relative to total non-office employment.

In the automotive parts supply industry, as shown in Table 14, sizable proportional increases occurred in the employment of heat treaters, inspectors, carpenters, electricians, pipe fitters, millwrights, machinists, maintenance welders and power truckers. Small proportional increases or no change in employment is evidenced by assemblers, floor and bench moulders and tool and die makers, while machine operators, set-up men, spray painters, machine moulders, machine welders, mechanics and unskilled labourers show a decline in their employment relative to total non-office employment.

Among those occupations on which information is available from both industries, all occupations show similar trends except carpenters, spray painters and machine welders. While the employment of carpenters is subject to erratic fluctuations due to occasional construction projects and major rearrangement of production facilities the same does not seem to be true of spray painters and machine welders.

The data in Tables 13 and 14 obscure the fact that a great diversity of employment trends in various occupations can be observed among the individual establishments. In order to demonstrate the various trends shown in the individual establishments, Table 15 shows how many of the individual establishments in the automobile manufacturing industry displayed the same trend as that for the whole industry.

In compiling Table 15, the employment data of one small establishment were not analysed in detail and employment data of two establishments of one large company were analysed jointly for technical reasons. By this means five individual establishment trends will be contrasted with the trend displayed by the whole industry with respect to each occupation.

Table 15 - Degree of Diversity Among Individual Establishments in the Automobile Manufacturing Industry as to Employment Trends Displayed in Various Occupations, 1950-1959

	Total non-office	Assembler	Body trimmer	Carpenter	Electrician	Grinder operator	Inspector	Machinist	Machine repair	Machine operator	Metal finisher	Millwright	Spray painter	Pipe fitter	Sheet metal worker	Tool & die + toolmaker + jig & fixture man	Power trucker	Welder torch	Machine welder
Number of establishments showing same trend as entire industry(1)	4	4	2	4	3	1	4	1	3	3	3	3	2	3	3	3	5	3	3
Number of establishments in industry reporting on occupation	5	5	4	5	5	4	5	4	5	4	4	5	5	4	3	5	5	5	4

(1) In the case of some occupations, there is a heavy concentration of workers in individual plants with the result that they dominate the industry totals.

In the automotive parts manufacturing industry similar diversity of occupational trends can be observed among the eight establishments.

The great diversity of trends displayed by individual establishments may be due to differences in size, the diversity of product mix or simply to the different timing of reorganization of the production process.

Chapter 4

An Analysis of Specific Technological Changes in the Automobile and Automotive Parts Manufacturing Industries

The primary purpose in analysing the manpower effects of specific technological changes was to gain insight into newly emerging training needs and the differential impact on occupations and skills, and to gain some idea of the overall impact of changing technology on the industry's total labour force and its composition.

The manpower effects of changing techniques can be looked at in quantitative and qualitative terms. It becomes important to explore the implications of both aspects in order to evaluate the full impact of any specific technological change.

Certain practical difficulties emerged in the course of the study which made it extremely difficult to quantify the manpower effects of technological change. In theory it would be desirable to know the changes in output for some period before and after the change in techniques, the direct manpower effects, the indirect manpower effects both in the establishment and other establishments, in addition to the time lags that occur between the introduction of a change in technique and the time its full manpower effects become evident.

Even if all the necessary data had been available, the fact remains that the information collected on specific changes represents information relating to a sample of an unknown universe and there are reasons to assume that the sample is not representative. One reason for such an assumption is that technological change occurs all the time and may range from the very small to very large-scale changes. The examples brought to our attention were of such a scale that people remembered them clearly and were able to recall them in detail. They were, in other words, relatively large-scale changes which had created an impression on the interviewee's mind. Consequently, it is highly probable that small-scale changes are not at all well represented in the sample.

For the foregoing reasons the quantitative information collected is insufficient to evaluate the full impact of specific changes on the labour force. For the most part, the information obtained is restricted to manpower directly engaged in the particular operation affected by a change, and in an overwhelming majority of cases, it was obtained in terms of rate of output per employee, rather than in terms of total employment before and after the change. Rates of output per man lend themselves readily to an analysis of the manpower effects of a change in techniques, assuming constant output, which assumption may not be realistic, primarily because of the fact that decisions to change techniques are intimately bound up with decisions to increase output. To proceed to analyse manpower changes on a constant output basis would, in a sense, measure "potential" effects because it would show what would have happened if the new level of output after the change had been produced by the old technique.

The information obtained was sufficient for analysing the sample of changes in qualitative terms. It was not, however, sufficiently detailed to determine quantitatively changes in training needs or occupational changes within a skill level. With respect to changes in training needs and occupational changes, the most that could be extracted from the information were impressions and generalizations.

Changes in the Automobile Industry

In the automobile industry, 62 specific instances of technological change were mentioned in interviews with company and union officials. Forty of these changes were reported in enough detail to evaluate their effects on the skill level of workers directly involved in the operation. By "workers directly involved in the operation" is meant those workers whose duties confine them to the particular operation. If five semi-skilled workers were engaged on an operation before the change and owing to the change were replaced by three semi-skilled operators and a maintenance mechanic who is required to stand by all the time, the skill level requirements would be considered to have increased. On the other hand, if the presence of such a maintenance man were not required and the installation of the machine would merely have raised the amount of maintenance work by an undetermined amount, eventually leading to an increase in the number of workers engaged in maintenance, the secondary effects would not be taken into account.

The secondary manpower effects of technological changes, which are not discussed in detail here, could occur in the plant where the change was instituted or outside the establishment. The two main difficulties in the determination of such secondary manpower effects both within and outside the establishment are implicit in their nature. First, the secondary effects of any specific change in technology have a diffused character and are not readily identified wherever they occur as having originated with the particular change in technology. Second, time lags of various durations elapse between the change and the primary manpower effects on the one hand and the secondary manpower effects on the other hand. These time lags, of which very little is known, tend to obscure even further the relationship between specific changes in technology and their secondary manpower effects.

Table 16 presents the changes in skill levels which occurred in connection with the forty changes.

Table 16 - Changes in Levels of Skill of Workers Directly Engaged on a Specific Operation in the Automobile Manufacturing Industry

	Skill level unaffected(1)	Lowered skill level	Increased skill level	Total
Number of specific changes	32	3	5	40
Per cent.....	80.0	7.5	12.5	100

(1) Unchanged skill levels do not exclude the possibility of extensive occupational shifts within a given skill level or changes in job content.

It is evident that, in the vast majority of cases, no change occurred in the skill level of manpower directly engaged on specific operations. This finding may reflect the fact that most of the changes took place in areas where low skilled employees had previously been employed. The increase in skilled manpower requirements is seldom direct and, as was pointed out earlier, the indirect manpower effects were excluded from the analysis. During discussions of these changes with both management and unions, the impression gained was that while only 12.5 per cent of the changes involved a direct, appreciable increase in skills, in almost all cases there was a slight increase in the general skill composition of the labour force due to more complicated maintenance and the operational requirements of newer, more complex machinery.

In order to arrive at some conclusions, however impressionistic, on the changes in training needs and occupational shifts, the 62 specific changes were analysed in terms of the "type" of change they represented. Presumably each separate type of change would have its characteristic manpower effects, and such information in conjunction with the frequency with which it was encountered would provide some insight into the dynamics of labour force composition. The 62 changes were classified as follows:

Table 17 - The Automobile Manufacturing Industry: Classification by Type of 62 Specific Technological Changes

	Use of automatic machinery	Use of integrated materials handling	Use of automatic controls	Changes in product design and/or methods of fabrication	Use of new materials	Changes in production process	Use of improved non-automatic machines	Use of improved hand tools	Improved materials handling or positioning	Introduction of new product or operation	Redesign + integrated materials handling	Improved tooling	Changes in materials + changes in production technique	Total
Number of changes..	6	3	3	1	2	8	13	2	14	3	2	4	1	62
Per cent.	10	5	5	2	3	13	21	3	22	5	3	6	2	100

Use of [illegible]: This type of change, which accounts for 10 per cent of the cases, usually eliminates a significant proportion of semi-skilled labour previously engaged in the operation. Frequently maintenance personnel are required to stand by all the time because of the potentially large cost of breakdowns. The calibre of the maintenance personnel required is high and competence in several maintenance trades as well as above average intelligence is preferred by management.

An example of this type of change is the installation of an automated plating machine in one establishment. Before the installation of the machine 39 men, of whom 4 had to have at least a half year's experience with the plating process, plated X square feet of surface in an 8-hour day. On the automated equipment, 23 men, of whom 4 needed at least a half year's experience with the plating process, were able to load, unload and inspect the same square footage. However, 3 maintenance mechanics were required to be constantly in attendance to prevent or repair breakdowns. The manpower data contain a slight bias, as it is not uncommon for the machine to complete the plating job in less than the eight hours on which the comparisons are based.

Use of Integrated Materials Handling: This type of change usually eliminates the jobs of unskilled materials handlers or increases the output significantly of processes utilizing semi-skilled labour. Normally maintenance requirements rise after the installation of such transfer machines but seldom to the degree where full-time maintenance is needed.

An example of this type of change is the installation of transfer machines in hood stamping operations. The hood panel and hood liner stamping, trimming and flanging operations are performed by three successive dies on large presses. These major operations are followed by several minor bending and trimming steps on smaller presses.

The mechanized set-up of this operation, the first of its kind in the plant, consists of an electro-hydraulic transfer mechanism between the first and second and the second and third presses. The first transfer mechanism also turns the piece upside down, to put it into the desired position for the following operation. The feeding of the first press is still done by hand and the removal of the finished hood is again done manually. The figures given by company officials show that before this piece of equipment was installed 13 men were working on this operation, whereas now only 6 are involved, while output has increased by about 40 per cent.

Use of Automatic Controls: By automatic controls are meant devices (mechanical, electrical or otherwise) which regulate the operation of a machine or a piece of equipment. The use of such devices usually has a limited impact on labour, because it manifests itself in the improved quality of the final product. If displacement occurs, it is concentrated within the inspection staff through greater uniformity of the product, or it may affect some semi-skilled or skilled occupations, but such effects are, as a rule, more than offset by the increased maintenance requirements of the control mechanisms.

The use of the electrostatic painting process for the spray painting of small parts is a good example of the use of automatic controls. The main effect of this process is that the wastage of paint is reduced and the uniformity of film is improved.

Changes in Product Design and/or Methods of Fabrication: Redesign of the product and/or changes in methods of production can affect the number and types of worker on specific operations in various ways. Typically, however, it raises both employment and skill requirements. The higher labour costs are offset by an improvement in the quality of the product.

Use of New Materials: The use of new materials either to be consumed in the production process or to be incorporated in the final product normally leaves total manpower requirements relatively unaffected. It manifests its effects in quality changes or in fairly extensive shifts in occupational skills required. It may happen that operators, inspectors, and maintenance tradesmen have to learn entirely new skills to cope with the particular properties of a new material (e.g., aluminium).

Change in Production Process: This type of change is usually far-reaching in all aspects of labour demand. It represents a complete change in the process by which an operation is carried out to produce a component or part. An example of this type of change will be described in the section of this report dealing with the automotive parts industry.

Use of Improved, Non-Automatic Machinery: This type of change consists of installing a newer, better machine in place of an older, lower capacity one. Normally output is increased significantly on the operation, which may or may not decrease total employment, depending on what the level of total output is after the change. Usually no occupational or skill changes occur and maintenance requirements do not change significantly.

An example of such a change would be the replacement of a milling machine with a broaching machine for the finishing of gasket surfaces on a cylinder block. The milling machine, in this example, finishes 35 units per hour with one operator; the broaching machine has a production rate of 75 units per hour with one operator. No significant increase in maintenance occurred in this instance.

Use of Improved Hand Tools: This type of change consists of the substitution of improved hand tools (power, air or manual) for older type, lower capacity tools. It may on occasion have significant manpower effects quantitatively. Occupationally it has no effect directly.

Improved Materials Handling or Positioning: This type of change may have manpower effects ranging from the very small to large. It usually eliminates unskilled jobs and raises output per semi-skilled assembler and machine operator. A slight rise in maintenance requirements is usually found to be the result of such technological change besides a noticeable increase in the work of tool makers, fixture men, etc. An example of this type of change will be described in the section of this report dealing with the automotive parts industry.

Introduction of New Product or Operation: This type of change constitutes an addition to the activities of any establishment. As such it raises manpower requirements in all categories of employment. Wherever additional activities are commenced, the establishment invariably adopts the most up-to-date techniques that are appropriate to the planned level of output.

An example of this type of change is the recent commencement of V-8 engine production in a large establishment. It created employment for approximately 300 people out of which approximately 40 per cent were in skilled occupations or in occupations requiring higher skills than skilled trades. The large proportion of skilled jobs reflects the very high degree of mechanization and integration of production processes.

Product Redesign plus Integrated Materials Handling: This type of change is complex in that it involves redesigning the product to adapt it to proposed new production processes involving integrated materials handling. Its effect on labour is generally similar to that pointed out in connection with integrated materials handling alone. This type of change highlights the interdependency of various kinds of technological change. In the instance under discussion, one type of change hinged on the prior introduction of another type of change. The dual-type category for interdependent technological changes used in this analysis includes only those cases where the two types of change were considered to be of equal importance.

Improved Tooling: Improved tooling refers to a technological change where more efficient tools or dies are substituted in machine operations. In general, such change increases output per machine operator and the total effect on employment depends on what increases in total output are desirable. Normally no change in occupations takes place and only slight changes are evident in maintenance functions. Employment in the tool room is increased, at times, to a very significant degree.

In one large plant included in the survey, better tools enabled machines to operate at higher speeds in the machining operations of cast iron components. While output stayed constant a number of machine operators were displaced.

Changes in Raw Materials plus Changes in Production Techniques: This type of change is a second category of complex change, consisting of a simultaneous change in the raw materials used and, consequently, in the appropriate production techniques. The manpower effects of such change are far-reaching. Total employment may increase or decrease significantly and both occupational composition and skill level composition are radically altered.

A typical example of such change would be the introduction of plastic materials for upholstery and the inside trim of automobiles.

Changes in the Automotive Parts Industry

In the automotive parts industry, 79 specific changes were analysed in terms of their characteristics. Of these, enough manpower information was available in 44 cases to complete an analysis of changes on the skill levels of workers directly involved in the operations. Table C details the analysis of these 44 specific technological changes in terms of skill levels affected.

Table 18 - Changes in Levels of Skill of Workers Directly Engaged on a Specific Operation in the Automotive Parts Manufacturing Industry

	Skill level unaffected[1]	Lowered skill level	Increased skill level	Total
Number of specific changes.....	39	5	-	44
Per cent.....	89	11	-	100

[1] Unchanged skill levels do not exclude the possibility of extensive occupational shifts within a given skill level or changes in job content.

Table 18 reveals that, in the overwhelming majority of cases, no changes in skill levels were involved. In just over 10 per cent of the cases, a lowering of the skill levels required for the job occurred, due to the change in production techniques. In no case did any specific change result in increased skill levels. This is in contrast to the automobile industry where there was an increase in skill level in 12.5 per cent of the cases. The proportion of cases where a lowering of the skill levels occurred was slightly higher in the parts industry than in the automobile industry. Secondary manpower effects of the 44 specific changes were again excluded from the analysis and this fact may have influenced the findings, particularly in respect to changed skill requirements, since in the parts industry the small establishment is more predominant. Because of this, it is very seldom, for example, that a maintenance mechanic is assigned full time to a single operation.

The classification of the 79 specific technological changes in terms of their characteristics is presented in Table 19.

Table 19 - The Automotive Parts Manufacturing Industry: Classification by Type of 79 Specific Technological Changes

	Use of automatic machinery	Use of integrated materials handling	Use of automatic controls	Changes in product design and/or methods of fabrication	Use of new materials	Change in production process	Use of improved non-automatic machine	Use of improved hand tools	Improved materials handling or positioning	Introduction of new product or operation	Redesign + integrated materials handling	Improved tooling	Changes in materials + changes in production technique	Total
Number of changes..	8	2	-	2	2	7	41	-	10	4	-	3	-	79
Per cent.	10	2	-	2	2	9	52	-	13	5	-	5	-	100

The characteristic manpower effects of each type of change in the parts industry are identical to the effects discussed in the case of the automobile industry.

In the discussion of specific technological changes in the automobile industry, it was stated that illustrations of a change in the production process and of improved materials handling and positioning would be drawn from the parts industry.

A good example of the former is the substitution of induction heating equipment for ordinary gas furnaces in the extrusion (forging) of valves, in an automotive parts company. This change in equipment eliminated the heater operator. This meant a considerable saving of manpower, but it also caused difficulties in the training of hammermen, since, under the old system, the heater operator's job was a step in the training process towards the position of hammerman. The elimination of heaters was slightly offset by a considerable increase in electrical maintenance on the high-frequency generator units. Because of the small size of the forgings involved in the case of valves, no helpers were required, hence there was no displacement in this respect.

An example of improved materials handling and positioning occurred in a small plant in 1957. The presses engaged in the production of small stampings were equipped with automatic feeding devices. There is still one operator to each machine but output per operator has increased 25 per cent.

It is of interest to note the different percentage distributions as to type of change in the two industries.

While the use of improved non-automatic machinery accounted for roughly 1 in 5 of the changes in the automobile industry, it accounted for 1 in every 2 changes that occurred in the parts industry. Improved materials handling and/or positioning was the most frequent type of technological change in the automobile industry, accounting for 22 per cent of all changes in the sample. On the other hand, in the automotive parts industry this type of change accounted for 13 per cent of all changes in the sample. A further interesting feature of such a comparison is the frequency of use of automatic machinery, which accounted for approximately 10 per cent of all changes in each industry. Dual-type changes, while not very frequent in the automobile industry, are conspicuous by their absence in the parts industry.

The relative frequency with which the different types of change occur in the automobile and parts industries has the value of affording some insight into the characteristics and frequency of the manpower effects of such changes in these industries.

Chapter 5

Some Problems of Human Adjustment to Technological Change

Technological change makes possible the creation of more and better goods and services, but it also creates a set of problems for both society and the individuals comprising it.

For society, technological change assists the speed of economic development provided the freed resources are utilized productively in alternative employment. Resources are, however, more or less specific and are not easily diverted into alternative, equally productive employment. What is true of resources, in general, applies to an even greater extent to human resources. In addition to their uniqueness in terms of skill, temperament and past job experience, workers have a set of relationships to their job, fellow workers, locality, customs and traditions. Such relationships tend to lower productivity when workers are diverted into alternative employment or, in extreme cases, may make it impossible for a worker to find alternative employment at all. Even if the last eventuality does not occur, a temporary fall in productivity is almost inevitable.

Technological change, like all changes, is a disequilibrating process and inevitably problems of adjustment come to the fore. From the point of view of society, the relevant question is whether the increased productivity of the new process compensates sufficiently for the possible lowered productivity of the diverted resources in their alternative employment. Even if it is beneficial, on balance, for society to change productive techniques, the individuals displaced by such change create an adjustment problem for society.

Generally, any individual in a market society is subject to the interplay of supply and demand forces in the labour market. The market forces determine to a great extent his home location, living standards, and social status. Technological unemployment in such circumstances presents very difficult choices to the individual worker. Each alternative way to adjust himself to the altered situation involves various hardships. Retraining necessitates considerable expenditure of time, money and energy. To move to locations where openings exist for which he is qualified, he must have funds, and such a move may necessitate leaving friends and perhaps his family behind. If he is strongly attached to the locality, he may prefer to take a job there at a lower skill level, with a corresponding loss of earnings and lowering of status.

The Effect of Technological Change on Various Groups of Workers

The differential impact of technological change on individuals will be governed by a number of factors. The general level of economic activity, the extent to which the establishment that employs him shares in the prosperity or depression of the industry, the individual's age and seniority, and his occupation and skill are all important determinants of the differential impact.

In times of expanding economic activity, it is considerably easier to effect any adjustments that become necessary through technological change. With the expansion of all kinds of jobs, provided the establishment shares in the general prosperity, seniority clauses in collective bargaining agreements favour the promotion of the senior employee who is capable and willing to perform the duties of the job that has become open. If any transfer becomes necessary, but such transfer does not involve a promotion, the seniority clauses provide that the junior employee will be transferred unless the transfer is made at the request of the employee. This transfer clause protects the senior employee in a given department that experiences a reduction in personnel, and furnishes the possibility of alternative jobs for junior employees in other departments.

Moreover, in times of labour shortages, establishments with unsatisfied labour demand are willing to extend assistance in the form of retraining programs, sometimes even undertaking the entire training at their own expense. At the same time, their standards of training are lowered, permitting applicants with lower qualifications than are usually acceptable to compete for the job.

During times of expansion in economic activity the main burden of any changes in technology falls on potential jobs, that is, job opportunities do not expand as rapidly as they would have with the older techniques. In this case the most seriously affected group in the labour force is the new entrants, who may find it more difficult to enter the labour force in an occupation or industry which they would have entered by preference had there been no technological change.

In times of declining economic activity, again provided that the employing establishment is affected by the general trend in the industry, total employment not only fails to increase but falls, with the result that lay-offs become necessary. Typical lay-off clauses in collective agreements provide that junior employees in terms of seniority have to be laid off first, as long as senior employees are able to perform the requirements of the remaining jobs. Such plant-wide seniority provisions are modified somewhat in two ways: first, within the framework of plant-wide seniority, departmental seniority lists are established and these govern the allocation of manpower; second, certain groups of workers may be excluded from the plant-wide seniority clauses of the agreement. Some of these excluded groups of workers (such as skilled tradesmen) may maintain their own seniority lists; some may be exempted altogether from seniority provisions, if attached to special jobs or special groups of classified occupations. Such exemptions are negotiated from time to time as the need arises.

The seniority provisions generally speaking protect the older worker except that, as was pointed out earlier, not all establishments are affected by the general economic trend to a uniform degree. Thus it may occur that in one plant employees with several years of seniority are laid off, while at another plant new employees are hired.

If and when lay-offs occur, they adversely affect the individuals displaced in the process of technological change. In no sector of the labour force, however, are the adjustment problems greater than among the older workers. Older workers, by whom are meant in this context individuals 40 years of age and over, have firmer roots in a locality, usually more extensive family obligations, and a greater investment in terms of time and effort in the job or skill which is displaced by the change in technique. Even when older workers are willing to make greater sacrifices, they are often "too old" to be hired somewhere else or not flexible enough to be retrained easily. In consequence, they become unemployable in a relatively short time or take occasional unskilled jobs, both of which impose hardships on the family and contribute very little or nothing at all to the welfare of the country.

Recent inclusions of severance pay provisions in a number of collective bargaining agreements tend to cushion the impact of technological change if it results in the permanent lay-off of older workers. The provisions tend to furnish some monetary assistance until alternative employment is found.

For those already employed in the industry, the preferential hiring clauses and transfer provisions tend to extend a degree of job security where operations are moved from one location to another. The relevance of such clauses to technological change arises from the fact that it is quite conceivable that the introduction of new techniques may necessitate the erection of a new plant, and management may decide in this event to move operations to a move advantageous location. In such a situation, the transfer clauses provide that an employee whose job is transferred to a new location shall be entitled to the same job at the new location if he is willing and capable, with no loss of any employee benefits which were accumulated at the old location. Preferential hiring clauses, where they apply, provide that when a plant is hiring new employees it will give preference to workers laid off from another plant of the same company. Preferential hiring clauses do not always ensure that there will be no loss of employee benefits which may have accumulated at the old location.

The number of collective agreements which contain such clauses on the one hand and the number of employees able to benefit from each clause on the other hand determine the relative protection which each clause in reality offers to workers in the industry.

In the automobile manufacturing industry there are 24 collective agreements on file with the Department of Labour covering in all 33,345 employees. The frequencies with which the clauses discussed appear in those agreements and the number of employees who benefit from them appear below.

Clause	Number of agreements containing clause	Number of employees covered by clause
Seniority re promotion	16	33,014
Seniority re lay-off	24	33,345
Seniority re re-hirings	22	33,293
Seniority re transfers other than promotion, lay-off and recall	14	32,775
Preference in re-employment on plant relocation or permanent plant shutdown (to other plants of company)	2	22,500
Severance pay provisions	10	30,736

In the automotive parts manufacturing industry there are 62 collective agreements on file covering a total of 13,914 employees. The same analysis which was carried out for the automobile industry yields the following frequency count for the parts industry.

Clause	Number of agreements containing clause	Number of employees covered by clause
Seniority re promotion	48	10,577
Seniority re lay-off	59	13,298
Seniority re re-hirings	56	13,222
Seniority re transfers other than promotion, lay-off and recall	31	10,776
Preference in re-employment on plant relocation or permanent shutdown (to other plants of company)	10	6,069
Severance pay provisions	6	5,030

While the various employment security clauses provide considerable protection for the older worker in general, they protect the younger worker less effectively. Because of this less effective protection, the younger workers as a group have somewhat different problems. Often displacement due to technological change affects them to a greater extent than the older worker, but in some ways they are better able to obtain alternative employment. They are more mobile, are less attached to locality and environment, have a smaller stake in the job or skill from which they are displaced, and lastly are usually preferred in hiring if other relevant factors are equal. Because of age, they may more readily take advantage of various company and public training schemes to improve themselves and learn skills which are in demand. That is not to say that problems associated with training the younger worker do not exist, but rather that adjustment to the changing demand for labour is relatively easier for them than for older workers.

Description of Three Labour Market Areas

The differential impact of changing technology in terms of the different determinants can be perceived, although not accurately measured, through a brief description of three different labour market areas.

Area A

In the last few years, manpower requirements in this area fell drastically for three reasons: the transfer to another locality of one large automobile plant together with some parts plants; the curtailment of production at another large industrial plant; and the introduction of manpower saving technology in the industries remaining in the area.

In conversation with laid-off older workers, the impression was gained that no alternative job opportunities existed, with the exception of some short-term jobs for certain skilled tradesmen. Yet very few of the workers have moved away to obtain jobs elsewhere. A number of them have taken occasional temporary jobs on the farms around the city or as day labourers on construction projects. The vast majority have exhausted their unemployment insurance benefits, are on relief, live with relatives or with their children and hope for a recall which likely will not come despite their preferred position on seniority lists. They feel that they will be unable to obtain jobs elsewhere because of their age, which feeling may or may not be based on a realistic appraisal of the situation. Such fear, however, is real to them and prevents effective job seeking outside the area. Accordingly, the older workers interviewed generally expressed great concern over the role of technological change and its manpower effects.

Area B

Area B refers to a city and its surroundings about fifty miles away from Area A. It is dominated by the chemical industry. The automotive parts plants play an important part in the economy of the area yet their relative importance is less than the relative importance of automotive plants in Area A.

In this area a different situation was encountered. Despite the fact that sizable reductions of the labour force had taken place in the two largest automotive parts plants, there was little or no chronic unemployment in evidence. The situation could rather be characterized as that of under-utilization of the displaced workers, as most of them had found employment as unskilled labourers in construction and on the farms. A number of them had been absorbed by the expanding chemical industry. Those employed by the chemical industry had moved mostly into semi-skilled jobs of approximately the same skill level as the jobs from which they were displaced.

The problem of technological unemployment was very much on the minds of union officials here. This can be partially explained by the proximity of the two areas and the fear of union officials that, in the future, absorption of displaced workers might be considerably more difficult than it had been in the past.

It is of interest to note that, according to union officials at B, at a time when demand for labour was declining in Area A and expanding in Area B, due to increased demand for chemicals, no more than a handful of workers from Area A had obtained employment in or around the city, despite the proximity of the two areas. This fact attests to the relatively low mobility of the labour force in Area A, particularly in the case of those over 40 years of age. All those who did move from A to B were younger people.

Area C

An interesting contrast to Areas A and B was found in C. There seemed to be relatively little concern here over technological change and its effects. This does not mean to imply that no consciousness of possible problems exists. Rather, it indicates that in this community the upward trend in automotive employment has made it relatively easy for all the manpower effects of technological displacement to be absorbed. Total employment on all skill levels has increased over the past years enabling older workers not only to hold their jobs but to bid on more attractive jobs by virtue of their seniority.

The differential impact of technological change on occupations and skills was sufficiently demonstrated by the data and the discussion in Chapter 3. It is important to note that seniority in transfers, promotion and lay-offs has an important influence in determining in what particular way such differential effects will manifest themselves in the plant labour force. Intimately connected with occupational changes due to changing technology are the changes in content of existing jobs or the emergence of entirely new jobs and subsequent determination of proper pay rates. Some collective agreements make provisions for the settlement of disputed points while others do not cover this area of potential conflict. Usually where such settlement method exists, the provisions make use of the grievance procedure.

This area of conflict seems to increase in importance with an increase in the speed of technological change and decreases in importance when the speed of change in productive techniques declines.

Chapter 6

Training in the Automobile and Automotive Parts Manufacturing Industries

The variety and extent of training that is provided in any establishment is usually considered a function of size. This investigation tends to support this generalization.

In the parts supply industry, the majority of firms have less than 1,000 employees and very little organized training is made available. This is partly due to the fact that in the past a sizable proportion of the employees who did receive training in this industry left after the completion of training and transferred to the automobile industry induced to do so by the higher general wage level in that industry(1) and the general similarity of the products made. The existence of this potential drain on skilled personnel diminishes the incentive in the parts industry to engage in formal training to any great extent. In the automobile industry, where large establishments predominate, varied and extensive training programs are in existence.

In both industries a very large proportion of training is informal, "on-the-job" training. This is inevitable, as formal training as a rule is not specific enough to enable a person to perform a particular job without additional informal on-the-job training. In fact, our dynamic economy demands that our schools and other institutions in the training field give a broad training to render the trainee more and more adaptable to the changes in manpower requirements. The adaptability of the trainee is not only important in case of significant changes in the occupational composition of the labour force but also because the quality of skills required in a specific occupation may on occasion change considerably.

In general, technical training in industry can be arbitrarily divided into three broad classes in terms of its purpose. It may aim at familiarizing a worker with a specific job, it may provide supplementary training necessary to update a worker's skills or knowledge, or it may provide the potential conditions for movement into occupations at a higher skill level. Each type may utilize both formal and informal training methods. Familiarization training, for example, usually consists entirely of on-the-job training, whereas the other two types utilize formal training in combination with informal training. Training to update skills is usually given when expediency requires it. It consists of a number of relevant formal courses, which are not part of a comprehensive plan, and which are designed to raise employees to a specified level of knowledge or skill. Formal training, as it is used in upgrading, is usually a planned program of specific courses, taking place over a span of time, and designed to impart to the trainee the theory and practical knowledge related to a field of work and to develop particular skills.

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(1) Wage Rates and Hours of Labour, 1958. Tables 57 and 58. Economics and Research Branch, Department of Labour, Ottawa, 1959.

The types of training utilized in the two industries under investigation differ somewhat. The methods of administering such training are also subject to considerable variation. Besides the obvious determinant of size, the nature of the product and the attitudes of management and unions seem to influence the quality and extent of training that is made available by each establishment.

Familiarization Training

On-the-job training to familiarize the worker with a new job may take place when a new employee is hired or when an old employee is transferred to a new job. Such training is, of course, provided in all establishments due to labour turnover and horizontal transfers. The duration of this type of training in the automobile and automotive parts industries may vary within wide limits. The majority of such training, however, on the semi-skilled level, such as for machine operators or assemblers, seems to consist of up to 40 hours of observing a fellow worker doing the job. Occasionally, longer periods are necessary to learn about the job, extending to as much as a few months, but such instances are relatively rare.

Familiarization training at higher than semi-skilled skill levels may last considerably longer. It is not uncommon in the automobile industry for a graduate engineer to be hired and subjected to a rotating "internship" in various departments for a period of two years before he is utilized fully in Canadian operations.

Often technical institute graduates, hired as fully qualified technicians, are subjected to a similar training program, the duration of which is somewhat shorter than for engineers.

Training to Update Skills

Training for the purpose of bringing skills up to date takes a variety of forms, and is usually restricted to skilled tradesmen, technicians, supervisory personnel and engineers.

The two most common forms of such training are the encouragement of night school attendance, with the provision of partial or full refund of expenses, and the utilization of the staff of equipment manufacturers to explain and familiarize selected employees with the theory and practice of the new and more complex machinery. The latter may be accomplished by sending such employees to the works of the machine manufacturer or by having the latter send a team of instructors to the location of the installation. Both forms of this type of training are frequently found among both small- and large-scale firms. Large companies, in addition to the types of training enumerated above, are able and willing to design and administer "refresher courses" in any field of technology, where and when the need is felt. Such refresher courses usually consist of 40 to 80 hours of lectures and discussion.

Numerous examples of such short-term formal training for purposes of updating skills were encountered. The following quotations from interviews with officials illustrate this type of training:

> "An example (of training) would be when trouble is experienced with some type of equipment. Last year the company had trouble with the mechanical conveyor belts and apparently the maintenance people on it had fallen behind the technological innovations and improvements; we gave them a short course to bring them up to date."
>
> "Whenever there is a change in materials used, we would offer a short course for supervisors to retrain them."
>
> "This year, due to design changes, trouble was anticipated so we gave a 54-hour retraining course to about 100 supervisors in the different welding techniques."
>
> "When this new machine was installed some people of the manufacturer's came in and trained our personnel."

Training for Upgrading

The third type of training, namely, training to prepare for the movement from one skill level to another, is both important and common in the large firms. It exists on but a very limited scale among the smaller firms. This generalization holds true for both the automobile and automotive parts industries with regard to apprenticeship schemes, non-apprenticeship schemes, technician training and engineer training. Out of eighteen parts supply firms and one automobile firm with fewer than 1,000 employees, only three had an organized apprenticeship plan; four others followed a policy of hiring young workers for on-the-job training combined with night school attendance. On the other hand, out of five large establishments in the automobile industry, employing over 1,000 workers, four had formal apprenticeship programs, three were engaged in the training of technicians through upgrading, and two were administering training schemes to qualify trainees at the professional level (engineering).

The formal part of training in apprenticeship, non-apprenticeship and technician training plans may be given within the establishment or in cooperation with public training institutions. Such training, whether given during the day or at night, in the establishment or in technical schools, is characterized by a definite pattern of subjects attended in a planned order.

Whenever and however administered, the existing apprenticeship schemes conform to a general pattern in all important aspects. Within the trades there is a tendency to emphasize automotive technology, in addition to the usual skills and knowledge involved in the trade.

Technician training plans at this time, perhaps because of their experimental nature, display considerable divergencies. Perhaps it would be of interest to summarize the more salient points of three plans which were encountered.

Plan I: As a rule, under this plan, candidates for technician training are obtained through hiring rather than from among the skilled tradesmen on staff, since a good educational background, such as high school graduation with good standing in science and mathematics, is prerequisite. The formal training consists of 15 to 25 two-hour classes, taken in the evening, in either hydraulics or electronics. Trainees are then encouraged to attent night courses leading to a certificate at the parent company's school in Detroit. Certificates are granted in the following courses: body draughting and design, mechanical draughting, chemical technology, electrical technology, mechanical technology, metallurgical technology, and plastics and rubber technology. Technicians are employed by the company in such fields as engineering, production planning, draughting, and testing.

Plan II: After regular apprenticeship training some of the journeymen are selected for a course of post-apprenticeship training which is designed to upgrade them to technicians. The post-apprenticeship training consists of night course attendance leading to a certificate. It is planned to use these technicians in such occupations as trouble shooter, materials expert, layout technician and quality inspector.

Plan III: Any employee, salaried or hourly rated, is eligible who has completed Grade 12 high school, but preference is given to employees who finished in the upper half of the class. The subjects which must be taken and the standards which have to be met closely conform to specifications laid down by the Ontario Department of Education for the Grade I and Grade II Advanced Technical Evening Course Certificate. These include the following obligatory courses for the Grade I Certificate: English I, Mathematics I and II, Mechanics I or Physics I. In addition to the obligatory subjects five optional subjects out of 21 must be chosen and standing obtained. For the Grade II Certificate, a further two obligatory subjects (English II and Mathematics III) are required plus seven optional subjects. Ninety per cent of tuition costs are refunded on successful passing of each subject. The same plan in this establishment is open to journeymen. Most apprentices are selectively hired with a view to eventual reclassification to engineering assistants.

In addition to these more or less formally structured training schemes for upgrading, night school attendance is as a rule encouraged for everyone. Generally this type of training does not lead directly to a higher level of skill and is not tied directly to any occupational movement. Considerable freedom is allowed to the individual in the selection of courses and no definite pattern of courses is prescribed. The encouragement to undertake such training is justified on the grounds that it makes individuals more flexible and builds up a potential manpower pool for promotions. As manpower

requirements beyond the immediate future are not foreseeable in any detail, any additional training that an individual obtains is welcomed and encouraged. The loose relationship between the individual and his future job allows greater freedom for the individual to select the type and pace of such additional training.

Training Plan Objectives

What all the formally organized training plans in these industries are designed to do at present is to train and develop the most suitable candidates for certain specific jobs at a certain skill level. The minimum requirements to qualify as a "suitable candidate" have, however, been steadily rising in the last few years in terms of general schooling and desirable personality traits. While this rise in entrance requirements was occurring, the greatest impact of displacement was being felt by unskilled and semi-skilled workers, with the result that the qualifications of the displaced worker were often found to be considerably below the minimum entrance requirements of the training schemes, in terms of both age and education.

Short familiarization training for jobs on the same skill level (the only training which could be utilized by the displaced semi-skilled or unskilled worker) could only be made use of to a very limited extent, owing to the fact that these were the very jobs which were eliminated and were becoming relatively scarce.

It would seem that training and retraining programs in these industries might become a more effective tool in the reintegration into the production process of the displaced semi-skilled or unskilled worker if there were more flexibility in entrance requirements as far as education and age are concerned. This might possibly be achieved through special training programs which attempted to train whatever manpower was available because of displacement up to the level where the displaced person could meet entrance requirements to the regular company schemes. When entrance qualifications bar the majority of displaced workers for reasons other than an educational deficiency, as age limit does in the case of apprenticeship, a careful review might be undertaken to see if liberalization of regulations would be possible or not. Recently, for instance, in some companies it was found that age limits for apprenticeship schemes were raised to the mid-thirties, with no visible harm to either the company or potential young apprentices, thus providing an opportunity for retraining to a sizable group of displaced workers.

A successful example of retraining a group of unemployed workers was recently carried out in one of the automobile manufacturing centres under Schedule M, which is financed and administered jointly by the federal Department of Labour and the provinces. Under this Schedule training is provided for unemployed persons who are registered with the National Employment Service and for whom no suitable work is available. Such persons receive short intensive training courses in occupations where there is likelihood of employment.

Training programs in industry and in public institutions have been discussed in terms of where and when displacement problems exist. It is quite possible that in certain locations, and at certain times, all displaced workers are absorbed without difficulty by a sizable increase in production or by other industries in nearby localities. However, it seems that, on the whole, it is relatively rare that no adjustment problems are raised by technological change and, under such circumstances, training could become one of society's most powerful means of facilitating adjustment to the new production process.

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